Message

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Sent: 12/16/2019 11:37:03 PM
To: Brasaemle, Karla [Karla.Brasaemle@TechLawInc.com]
Subject: RE: Comparison of Navy Inputs for BPRG and RESRAD BUILD - short answers to questions

Karla - Please see below. We can discuss on Wednesday.

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From: Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>
Sent: Thursday, December 12, 2019 4:31 PM
To: Praskins, Wayne <Praskins.Wayne@epa.gov>
Subject: FW: Comparison of Navy Inputs for BPRG and RESRAD BUILD - short answers to questions

Hi Wayne,

Here are short answers from Jana:

1. a.) I believe the BPRG default assumption of no dissipation of the source term does explain most of the difference in the risk estimates. Quantifying the difference in regards to providing a comparison to RESRAD would be a very difficult if not impossible task due to the complexities in the RESRAD model. We could, however due some rough hand calculations to calculate the reduced surface concentration by year and re-run risk by year (for years 1-26), then add the risks for each year and see what the result would be. Please let us know if you would like us to attempt this.

   => The Navy's RESRAD runs assume the source depletes over 26 years. How about re-running RESRAD with the Navy's assumptions except for source dissipation/depletion (i.e., set to zero) to see how much difference that makes in the RESRAD risk estimates? Would that be useful and relatively easy to do? And/or re-running BPRG with a nonzero dissipation rate?

   The ingestion pathway appears to be the big difference between the BPRG and RESRAD risk estimates. For the three radionuclides I compared (Ra226, Th232, Cs137), BPRG risks via the ingestion pathway are 3 to 4 orders of magnitude higher than RESRAD.

   If so, is this right?

   - In the BPRG, risk from ingestion is proportional to: "source concentration" x "hand-to-mouth rate" x "finger surface area" x "fraction transferred" x "saliva extraction factor."
   - RESRAD estimates risk from ingestion in two ways: 1) directly from the source (called "direct ingestion") and 2) ingestion of settled dust that originates at the source but is attenuated by a removable fraction factor, an air release fraction, air modeling to get a deposition rate for airborne dust (based on air exchange rate, deposition velocity, resuspension rate, and other assumptions), and then an "indirect" ingestion rate.
   - For HPNS, the Navy set ingestion directly from the source to zero (default, as described in the RESRAD user's guide), so the ingestion contribution to risk is from ingestion of settled dust
   - The BPRG assumes that radioactivity present in an area equal to the finger surface area is ingested multiple times per hour. Assuming roughly 10cm2 for finger area (3.7 for children and 11.5 for adults) and ~ 5 hand-to-

mouth per hour (17 for children and 1.65 for adults), that would be 50cm2/hr. RESRAD assumes that settled dust that is deposited on the building floor is ingested at a rate of 0.000112 m2/h, which is equal to 1.12 cm'/hr. BPRG is higher by a factor of close to 50.
- The BPRG assumptions for "fraction transferred" (weighted ave ~0.25) and "saliva extraction factor" (0.5) are several times higher than the RESRAD "removable fraction" (0.2) and "air release fraction" assumptions (0.357, the default for "building occupancy," according to RESRAD user's guide)
- In addition, RESRAD attenuates the concentration airborne dust to get a settled dust concentration through the use of an indoor air model. I didn't try to estimate how much the model reduces the concentration of airborne dust to get a settled dust concentration.

b.) The rate of dissipation in RESRAD is calculated through several equations that include the fraction of surface contamination released to air (default 0.357) followed by an equation that accounts for resuspension, disposition, and air exchange which dissipates the fraction in contamination suspended in air, and a physical erosion rate in cm/day.

2. a.) Other possible reasons the BPRG risks are higher could be due to how the calculator equations calculate ingestion rate using hand to mouth transfer rate, number of events, surface area of fingers, removable fraction, fraction transferred to skin, and saliva extraction factor) multiplied by 6 hours per day for the surface area for hard surfaces and 10 hours per day for soft surfaces. (For example, the BPRG rate of three transfers per hour for an adult seems high. Similarly, the BPRG rate of 17 transfers per hour for a child may be appropriate for a toddler, but not for an older child). In contrast, RESRAD uses a straight ingestion rate.

   => The Navy files indicate that they did not use a value of 3 for the adult hand-to-mouth transfer rate; they reduced it to 1.64.

   b.) Yes – the other differences between the calculators have an unknown impact due to differences in how the parameters are defined and the use of different equations/modeling.

3. a. and b.) Information about the lack of inclusion of all long-lived progeny was obtained from Section 3.2.3 in reference document #11 in the TM: *RESRAD for Radiological Risk Assessment Comparison with EPA CERCLA Rules – PRG and DCC Calculators*, Argonne National Laboratory, July 2015. https://www.researchgate.net/publication/282813932
   However, it is unclear whether this is still true in the latest version of the BPRG calculator (i.e., the statement that long-lived progeny are not included, is still true for the first option in the BPRG calculator where secular equilibrium is assumed). We have not attempted to ascertain this, as it may require contacting Fred Dolislager.

   c.) If Option #2 in the BPRG calculator "(Does Not Assume Secular Equilibrium, Provides Results for Progeny Throughout Chain (with decay): *BPRGs calculated with half-life decay as identified in the BPRG equation images. In addition to the selected isotope, all the individual progeny BPRGs are displayed. Each BPRG is determined with each isotope's respective half-life and not that of its parent isotope. This option does not assume secular equilibrium and presents all the individual progeny BPRGs,*" is selected, then all progeny can be included.

4. Options 2 and 3 now do allow the user to enter specific concentrations for all progeny, however the BPRG does not provide time integration of concentrations which will affect the calculated risk.

   => Please explain. What is meant by "the BPRG does not provide time integration of concentrations…"

5. No, I did not try to reproduce the Navy's BPRG simulations. Please let us know if you would like TechLaw to attempt this.

   => Did you try to reproduce any of the RESRAD BUILD runs?

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From: Praskins, Wayne <Praskins.Wayne@epa.gov>
Sent: Wednesday, December 11, 2019 8:26 PM
To: Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>
Subject: RE: Comparison of Navy Inputs for BPRG and RESRAD BUILD

Karla –

Thanks. My main questions are:

1. The two calculators make different assumptions about source erosion/dissipation. The TM says that the BPRG default assumption of no dissipation may grossly overestimate ingestion and risk. Does this assumption explain most of the difference in the risk estimates? Can you quantify the impact of the different assumptions on the risk estimates?

   The table in the TM says that the dissipation rate in RESRAD is "calculated linearly with time." Does the rate vary linearly over time, or the source concentration? Does the Navy provide any justification for their assumed rate?

2. Are there other possible reasons why BPRG risks are so much higher? Is it correct that the other differences between the calculators identified in the TM either decrease the BPRG risk estimates (e.g., BPRG inability to include risk from long-lived progeny and radon exposure) or have an unknown impact on risk (limitations in how the BPRG handles decay and ingrowth)?

Also,

3. The TM says (in item B) that risks from long-lived progeny and the long-lived progeny's short lived radionuclides are not included in the risk estimates. What is the source of this conclusion? Is this true for all three BPRG "source and decay output" options?

4. The TM says "The EPA BPRG Calculator is a static model, it models risk based on the initial concentration of the parent radionuclide (with no decay) does not have the capability to model the variation of radionuclide concentration as a function of time." Don't BPRG option 2 and 3, as stated in the TM, account for decay?

5. Did you try to reproduce any of the Navy's BPRG simulations?

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From: Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>
Sent: Wednesday, December 11, 2019 3:48 PM
To: Praskins, Wayne <Praskins.Wayne@epa.gov>
Subject: Comparison of Navy Inputs for BPRG and RESRAD BUILD

Hi Wayne,

Here is the draft final document regarding the BPRG calculator and RESRAD-BUILD. This one focuses on the difference between the Navy inputs for the two calculators.

Please let me know if you have any questions.

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